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THE PLANT DISEASE REPORTER

Issued By

Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

Supplement 124

PROCEEDINGS OF THE THIRD NATIONAL PLANT NEMATODE CONFERENCE

November 1, 1940

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

PROCEEDINGS OF THE THIRD NATIONAL PLANT NEMATODE CONFERENCE

First Annual Meeting of the Plant Nematode Conference
Birmingham, Alabama, February 9, 1940

In Connection with the Annual Convention of the
Association of Southern Agricultural Workers

Edited by
Howard P. Barss, U. S. Department of Agriculture

Plant Disease Reporter
Supplement 124 November 1, 1940

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LIST OF PERSONS IN ATTENDANCE:

G. M. Armstrong	Clemson Agricultural College, Clemson, S. C.
H. D. Barker	Bureau of Plant Industry, U.S.D.A., Washington, D. C.
H. P. Barss	Office of Experiment Stations, U.S.D.A., Washington, D. C.
John T. Belue	Extension Specialist in Cotton, Auburn, Ala.
A. N. Brooks	Agricultural Experiment Station, Lakeland, Fla.
K. Starr Chester	Agricultural Experiment Station, Stillwater, Okla.
E. E. Clayton	Bureau of Plant Industry, U.S.D.A., Washington, D. C.
A. A. Dunlap	Agricultural Experiment Station, College Station, Texas.
J. C. Frink	Alabama Polytechnic Institute, Auburn, Ala.
G. H. Godfrey	Texas Substation No. 15, Weslaco, Texas.
A. L. Harrison	Agricultural Experiment Station, Yoakum, Texas
R. J. Haskell	Extension Service, U.S.D.A., Washington, D. C.
H. H. Hume	University of Florida, Gainesville, Fla.
G. A. Jenkins	Agricultural Experiment Station, Experiment Ga.
C. C. Johnson	Innis Speiden & Co., New York City.
C. J. King	U. S. Field Station, Sacaton, Ariz.
S. G. Lehman	Agricultural Experiment Station, Raleigh, N. C.
C. W. McBeth	Coastal Plain Experiment Station, Tifton, Ga.
G. K. Middleton	Agricultural Experiment Station, Raleigh, N. C.
L. E. Miles	Agricultural Experiment Station, State College, Miss.
K. P. Morris	State Department of Agriculture, Tarrant, Ala.
E. G. Moss	Tobacco Experiment Station, Oxford, N. C.
Juliette Oliveira	Pineapple Experiment Station, Honolulu, Hawaii.
R. F. Poole	Agricultural Experiment Station, Raleigh, N. C.
C. D. Sherbakoff	Agricultural Experiment Station, Knoxville, Tenn.
B. T. Simms	U. S. Regional Animal Disease Laboratory, Auburn, Ala.
A. L. Smith	Agricultural Experiment Station, Experiment, Ga.
A. D. Stuart	North Carolina State College, Raleigh, N. C.
A. L. Taylor	Coastal Plain Experiment Station, Tifton, Ga.
W. H. Tisdale	DuPont Company, Wilmington, Del.
B. L. Wade	U. S. Regional Veg. Breeding Laboratory, Charleston, S. C.
J. L. Weimer	U. S. Bureau of Plant Industry, Griffin, Ga.
W. J. Wilson, Jr.	Fruit & Truck Experiment Station, Hammond, La.
P. A. Young	Agricultural Experiment Station, Jacksonville, Texas.

OFFICIAL BUSINESS

The conference was called to order by the Chairman, Dean H. Harold Hume. Howard P. Barss was asked to serve as secretary for the meeting.

Professor Hume briefly called attention to the seriousness of the problem created in the United States, particularly throughout the southern half, by the microscopic plant parasites known as eelworms or nematodes. He stressed the fact that no group of parasites of equal importance had been so neglected from the research standpoint. Although it has been suggested by those closely in touch with the situation that no single plant pest is probably responsible for a larger amount of loss to the farmers of the country, year after year, than the root-knot nematode, because it attacks such a wide range of important crop plants, there still has been but a relatively small amount of work thus far on selection and breeding for nematode resistance in these major crops. He declared that the situation created a challenge to the agricultural experiment stations and the scientific workers in the Government to aid agriculture in finding effective ways of cooperating with the numerous plant nematode problems. He urged workers to cooperate with each other in a more vigorous attack on nematode problems and expressed gratification that the evidences of progress were so encouraging at the present time as testified by the titles of the papers to be presented at this conference.

Dean Hume then stated that the Committee on Arrangements for the conference had met the previous evening and had decided to recommend the establishment of a permanent organization. The secretary was then called upon to read the recommendations of the committee. After a brief, favorable discussion the recommendations were adopted without dissent and the Plant Nematode Council came into existence. The recommendations follow:

THE PLANT NEMATODE COUNCIL:

The Recommendations of the Plant Nematode Committee adopted by the Third National Plant Nematode Conference at

Birmingham, Alabama, February 9, 1940.

It is the recommendation of the present committee that this organization be made permanent.

That it shall be known as the Plant Nematode Council.

That its purpose shall be to promote research on plant nematode problems and to facilitate mutual assistance among the workers.

That membership shall be given to all interested in plant nematode research.

That the existing committee shall become the executive committee; that it shall have power to increase or otherwise change its membership, and to select a chairman and a secretary; and that it shall prepare and submit to the membership a program of suggested activities.

The Executive Committee met immediately after the conference and elected Dean H. Harold Hume, University of Florida, chairman and Howard P. Barss, U. S. Department of Agriculture, as secretary. G. H. Godfrey, of Texas, R. J. Haskell of the U. S. Extension Service, H. D. Barker of the U. S. Bureau of Plant Industry, and B. L. Wade of the Southeastern Regional Vegetable Breeding Laboratory, were added to the Executive Committee which already consisted of H. Harold Hume, Florida, H. P. Stuckey, Georgia, R. F. Poole, North Carolina, C. D. Sherbakoff, Tennessee, S. A. Wingard, Virginia, K. C. Barrons, Michigan, and G. Steiner and E. E. Clayton, U. S. Department of Agriculture.

It was tentatively agreed to hold another general conference of all interested in plant nematode research the following year, preferably in conjunction with the Association of Southern Agricultural Workers. It was decided that one of the first steps of the Council should be to work out, if possible, a means whereby workers in various states could cooperate in more systematic testing of varieties of crop plants, forage plants, erosion-control plants, as well as other kinds of plants for resistance to nematodes.

ABSTRACTS OF PAPERS ON THE PROGRAM

The following contributions were made to the program, most of which were presented in person. Others sent in by workers who could not attend were read before the session. One or two are included which failed to arrive in time for presentation but whose contents were deemed of interest to those working with plant nematode problems.

INDUCING UNIFORM SOIL INFESTATIONS OF THE NEMATODE HETERODERA MARIONI AS AN AID IN BREEDING FOR RESISTANCE TO ROOT KNOT. Keith C. Barrons, Michigan State College, East Lansing, Michigan.—In connection with breeding work on root-knot resistance in beans and cowpeas at the Alabama Experiment Station preliminary experiments indicated that even in soil badly infested with nematodes, considerable variation occurred in the degree of root-knot infestation even among the plants of relatively pure varieties. Insuring a uniform and severe epidemic is a major problem in testing plants for resistance to any disease, particularly in breeding work when making individual plant selections.

In a test for uniformity of root-knot infestation, lima beans and snap beans were grown in naturally infested soil, but in alternate rows about 50 g. of severely knotted, chopped-up tomato and bean roots were put into each yard of furrow below seed level prior to planting. When the plants were dug up a distinctly "spotted" condition of infestation was disclosed, particularly on the uninoculated rows. Inoculation, however, had increased the amount of root knot in the lightly infested areas. Relatively large quantities of inoculum were added to the soil on several occasions in an effort to establish a uniform infestation plot, but tests with Henderson Bush lima showed wide variation in attack and often a distinctly spotted condition. Many of the plants always appeared lightly infested.

A plot of about 1,000 tomato plants was then inoculated by mixing a small handful of root-knot inoculum in the soil under each transplant when set. About 90 percent became heavily infested. Again, with varieties of the common bean and lima bean, a small handful of inoculum was mixed with the soil in a 6-inch area 6 inches deep in each hill before planting. When dug in 12 weeks, little variation was noted in the degree of infestation within a variety, practically all plants of susceptible varieties being heavily infested.

In a number of breeding experiments where this method was used rather uniform soil infestation was obtained as indicated by tests with a highly susceptible kind. The results were never perfect. Always a few plants appeared intermediate and few lightly infested. Even though absolutely uniform root-knot infestations cannot be induced, the methods described are of definite value in reducing variation and thus increasing the dependability of results. However, in developing resistant crops, further knowledge concerning the occurrence of geographic races as well as host-specialized races of the root knot nematode would also be of considerable value to the plant breeder.

REMARKS ON ADDITIONS TO A LIST OF HOSTS OF THE ROOT-KNOT NEMATODE. Edna M. Buhrer, U. S. Department of Agriculture, Washington, D. C.—Fifty-five new host plants of the root-knot nematode, representing most of the continents of the world, have been added to records in the Division of Nematology (U. S. Department of Agriculture) since additions to the 1933 list were published in the Plant Disease Reporter for July 1, 1938. There are now 1,387 species, representing 125 families. Specific remarks were made about infestations on Lespedeza stipulacea, Korean lespedeza, Pinus lambertiana, sugar pine, and other plants.

RESISTANCE TO ROOT KNOT NEMATODE IN NICOTIANA. E. E. Clayton, U. S. Department of Agriculture, Washington, D. C.—Studies on the carry-over of nematode populations following cropping with peanuts, resistant soybeans and cowpeas, cotton, corn, etc., have shown that only a few crops are resistant enough to actually starve out the nematodes. Even Brabham peas and corn are sufficiently parasitized to cary over maximum nematode populations.

There is an important difference between apparently resistant and definitely immune plants. To provide a sound basis for the breeding of either resistant or immune tobaccos, extensive tests have been made with the cultivated N. tabacum and other Nicotiana species.

Within N. tabacum varying degrees of resistance were found, evidently conditioned by a number of genes. Encouragingly, it has been possible (1) to eliminate certain lines, like White Honduras, where nematode resistance is apparently linked closely with a number of undesirable growth characters; (2) to eliminate many lines with intermediate types of resistance; and (3) to locate, and establish, with repeated selfing, apparently homozygous lines of N. tabacum with a rather high degree of nematode resistance. These lines are now being used in first and second back crosses.

Many of the species of Nicotiana were found highly susceptible, as bigelovii, maritima, langsdorffii, glutinosa, and goodspeedii. Others, however, are highly resistant to immune. These include longiflora, megalosiphon, repanda, nudicaulis, and nesophila. Such species provide genetic material far superior, from the viewpoint of resistance, to anything discovered within N. tabacum. With the new methods of inducing polyploidy, the problem of inter-species crosses has been much simplified. Thus work is proceeding with a tabacum X glauca tetraploid with a view to transferring the high nematode resistance of glauca to tabacum. Similar work is in progress with other highly resistant to immune Nicotiana species.

The ultimate aim is to produce locally well-adapted commercial tobacco varieties that are nematode-resistant and to develop basic breeding stocks available to anyone undertaking a tobacco-breeding project in which nematode resistance is an object. To this end an attempt is being made to eliminate, if possible, down to a single source of near-immunity that is conditioned by one or two genes. In tobacco present resistance is of an intermediate type dependent upon multiple factors and hard to use. The need for near-immune, easily handled basic breeding materials has led us to give much attention to the other Nicotiana species, rather than to confine attention to the resistance occurring in cultivated tobaccos.

THE BULB NEMATODE (DITYLENCHUS DIPSACI) IN NARCISSUS PLANTINGS IN WESTERN OREGON. Chas. A. Cole, State Department of Agriculture, Salem, Oregon.—The State of Oregon, together with the State of Washington, produces more than 100,000,000 narcissus bulbs each season and the crop is an important item in the nursery income of these 2 States. In our field work in nematode control it seems to us that the resistance of the bulb nematode to hot water treatment varies with the section within the State. In order to test out this idea, a series of experiments are being conducted in cooperation with Mr. W. D. Courtney, Assistant Nematologist of the U. S. Department of Agriculture.

The established method of treating for 2 1/2 hours at 110° to 111 1/2°F., first used in Oregon, was not effective in practice and the period has been increased to 4 hours. We find that with some varieties even a 4-hour treatment does not always give a complete kill. This makes us wonder if the cell structure of some varieties renders them heat resistant. The latest control methods used in this State include a presoak at 70°F. for not less than an hour, a precook at 110° to 111 1/2° for 45 minutes and a 4-hour treatment at that temperature. One pint of formaldehyde is added to each 35 gallons of water in the bath to prevent basal rot. It also makes the treatment for nematode more effective.

In field observations over 3 years, following treatment at 2 1/2, 3, and 4 hours, no evidence of nematode would show up during the bloom inspection the next spring but it would appear, at least in the 2 1/2 hour treated lots, in the foliage the second season, especially in the Portland and Brookings sections. In the Tillamook section a 3 or 3 1/2-hour treating period eliminated the nematode. Some details of the hot water treatment of narcissus need further study to determine the proper time for digging and treating. Furthermore, we find that it is almost impossible to eliminate the nematode from Chinese Lily and Paper White Narcissus. This nematode control is quite a problem with us, as our quarantine now requires the treatment of all planting stock every 2 years whether infested with nematode or not.

SOME OBSERVATIONS ON THE DEVELOPMENT OF ROOT-KNOT NEMATODE DISEASES IN VIRGINIA. S. P. Fenne, Extension Service, Blacksburg, Virginia.—In Caroline County, where farmers have been growing certified Nancy Hall sweet potatoes, it was found during the past year that certain fields on at least 2 farms were heavily infested with root knot. In working with these growers in an attempt to give them a rotation that will reduce the nematode population, the supposedly resistant Laredo soybeans were grown. Just before cutting time these beans were examined and found to be very heavily infested with root knot. Some of the roots were an inch or more in diameter. The second situation exists in the 4 counties of the Northern Neck, Virginia, where tomato plants from a State farther south have been used for the last 2 or 3 years. Some of the plants obtained last year were badly infested with root knot, resulting in a decreased yield of from 15 to 75 percent in some cases. Growers in that area are now demanding that a quarantine be set up to prevent the entry of root-knot infested plants.

HOT WATER TREATMENT FOR THE CONTROL OF NEMATODES IN WOODY PLANTS. G. H. Godfrey, Lower Rio Grande Experiment Station, Weslaco, Texas.—Abstract not received.

SOME SUGGESTIONS FOR QUICK TESTING OF NEMATODE RESISTANCE IN PLANT BREEDING PROGRAMS. G. H. Godfrey, Lower Rio Grande Experiment Station, Weslaco, Texas.—Reference is made to an earlier paper, (Some techniques used in the study of the root-knot nematode, Heterodera radicicola. Phytopath. 21: 323-329), with the suggestion that certain phases of the technique described therein might be used to advantage for obtaining quick readings on root-knot nematode resistance in plant breeding programs. Careful application of the method would eliminate the complication and delay brought about by chance "escape" from infestation on the part of a few plants in a progeny population.

CONTROLLING ROOT-KNOT NEMATODES IN POTATOES IN THE KLAMATH BASIN BY MEANS OF IRRIGATION. A. E. Gross, Oregon Agricultural Experiment Station, Corvallis, Oregon.—The root-knot nematode, (Heterodera marioni), was first identified in the Klamath Basin in 1923 on potatoes originating from stock from another State. Since then the eelworm has been found on some other farms resulting in heavy losses to a limited number of growers. In 1936 an intensive survey was made and funds were provided by the Oregon Legislature to develop practical control methods.

The survey showed that on certain farms, while abundant root-knot on weeds and crop plants indicated heavy soil infestation, yet potato crops were being harvested showing few or no nematode symptoms on the tubers. At the same time other fields apparently no more heavily infested were sustaining rather heavy tuber attack. The heaviest infestation was normally on the ridges or higher areas. In 1938, soil temperature readings started in mid-August showed rather wide differences on farms in the same district having similar soil but different irrigation practices. In fields irrigated every 3 to 5 days the average daily soil temperature was around 63° to 65°F. Fields irrigated at intervals of 7 to 9 days showed temperatures as high as 80°. Low temperature fields showed no external tuber symptoms at digging time although the roots of weeds and of potatoes indicated a heavy, general nematode population. A high-temperature field produced tubers 19 percent of which showed external symptoms.

These facts suggested an experiment, conducted in 1939, in a field that appeared to have a heavy and somewhat uniform nematode infestation. Irrigation of the different plots was conducted, after the first week, at intervals of 1, 2, 3, 4, and 5 days. Temperature readings were made each day at about 10:00 a.m. at 6-inch depth in the rows. The plot averages were 64.8°, 65.3°, 66.0°, 66.5°, and 67.5°, respectively. Irrigation started July 7, ended August 23. The water applied averaged 73°, coming from a canal about half a mile away where the water averaged 65°. The tubers were dug October 18. The percentage of tubers showing external eelworm symptoms was 48.6, 46.6, 33.4, 51.6, and 52.4, respectively. While the results demonstrated that soil temperature can be lowered through evaporation of irrigation water from the surface, the slight reduction in visible tuber symptoms apparently achieved by irrigation control in this test indicates the need for improved technique.

CONTROL OF ROOT KNOT IN FLORIDA CIGAR-WRAPPER TOBACCO FIELDS. Randall R. Kincaid, North Florida Experiment Station, Quincy, Florida.—An experiment was begun at Quincy, Florida, in the fall of 1937 on 1 acre of shade field where 15 consecutive crops of cigar-wrapper tobacco had been grown. The soil was heavily infested with root-knot nematodes. Treatments were in quadruplicate plots having a net area of about 1/35 acre each. Crops of tobacco were grown each year, and harvested, cured, sweated, and graded according to usual commercial practices. All plots were plowed in January and treated alike until the end of the crop season in July. The first series were kept in clean fallow by frequent plowing from July until January. In the second series the tobacco roots were removed from the field and the soil kept in clean fallow. In the third series clean fallow was followed by a cover crop of oats from October to January. All three produced good crops in both seasons with no significant differences. The fourth series in which unsuccessful attempt was made to grow sorghum in rows from July to November, followed by fallow, showed a significant increase in root knot and a reduction in yield. The fifth series, where native vegetation, mostly grasses, grew from July to January, showed a further small reduction in yield due to an adverse effect of the cover crop of native grasses, rather than an increase in nematode population. The tobacco grade index for the 5 treatments was practically the same.

COMPARISON OF CROP ROTATION AND FALLOWING AS METHODS OF CONTROL FOR ROOT KNOT OF COTTON UNDER IRRIGATION. C. J. King, U. S. Department of Agriculture, Sacaton, Arizona.—A cotton-alfalfa rotation practiced for 20 years on an area affected by root-knot nematodes indicated that satisfactory yields of American-Egyptian cotton could be maintained under conditions of the experiment, if the intervals between alfalfa were not greater than 2 years. It appeared that high yields of upland cotton could be maintained for several years without return of the area to alfalfa. The practice of clean fallowing combined with deep tillage in summer for 3 years was found effective in eliminating nematodes as a damaging factor to American-Egyptian cotton for one year and no serious damage resulted the second year although some of the area had been reinfested.

One year of alfalfa showed advantages over one year of fallow in improving production of American-Egyptian cotton in an area heavily infested with root-knot nematodes.

On the basis of the information obtained in these experiments, alfalfa rotation would appear to be equally as effective as and much more profitable than fallowing as a practical method for the control of root-knot nematodes affecting cotton.

THE RENIFORM NEMATODE AS A ROOT PARASITE. M. B. Linford, Juliette M. Oliveira, and Francis Yap, University of Hawaii, Honolulu, T. H.—A nematode, Rotylenchulus reniformis Linford and Oliveira 1940, that necessitates erection of a new genus of the Tylenchidae, occurs on Oahu, Territory of Hawaii,

as a mildly pathogenic parasite of roots. Over 60 known host species represent 29 families of plants. Injuries include minute cortical lesions and mild hypertrophy in the stele. Larvae of typical eelworm shape develop in the soil, without feeding, into mature nonfeeding males and invasive young females, both resembling larvae in size and shape. Females penetrate intracellularly into the cortex of roots, coming to rest with the feeding stylet inserted into an endodermal cell. This cell and nearby pericycle parenchyma enlarge and become densely protoplasmic. The posterior part of the female, usually on the root surface, enlarges to become reniform, then eggs are laid in a gelatinous matrix, forming a mass that covers the reniform body and adheres to root and soil. In naturally infested soil, of a moisture content near the wilting percentage for plants, the reniform nematodes exceeded 50 percent survival during 36 weeks. In soil air-dried 33 weeks, with moisture dropping to 1/5 of the wilting percentage, there was more than 5 percent survival. This nematode appears less tolerant to freezing in soil than does the root-knot nematode. (From Phytopath. 30: 15)

A COMPARISON OF THE ROOT-KNOT NEMATODE AND THE MEADOW NEMATODE. C. W. McBeth, U. S. Department of Agriculture, Tifton, Georgia.—The root-knot and meadow nematode may be confused in the larval stage, especially where they are stained within the plant tissue. The main distinguishing characteristics are as follows:

1. The meadow nematode larva is considerably more chunky than that of the root-knot nematode. 2. The lip region of the meadow nematode is more heavily cuticularized. 3. The spear or stylet of the meadow nematode is much heavier with more prominent basal swellings. 4. The tail is blunt or rounded in the meadow, and rather pointed in the root-knot nematode. These differences are very easily seen under the high power microscope but are rather obscure under the dissecting microscope, especially when the nematodes are embedded in the plant tissue.

Probably the easiest way to distinguish the two within the plant tissue is by body width, shape of tail, and arrangement or position in the root. The root-knot larvae are, as a rule, found near the root tip, the body outstretched with the head end embedded in the central cylinder and pointing toward the plant. The meadow nematodes are always found in the cortex, some outstretched and others curled. Frequently the stylet can be seen in the meadow nematode, but not always.

After the nematodes become mature, there is no resemblance between the two, the meadow nematode retains the worm-like form while the root-knot nematode becomes pear shaped.

A lantern slide demonstration was given to illustrate the possibility of confusing the two.

RECENT ROOT KNOT DAMAGE IN POTATOES. John T. Middleton, Citrus Experiment Station, Riverside, California.— Potatoes harvested from a 40-acre field in Southern California were severely infested with nematodes. About 40 percent of the crop was lost on this score alone. In an adjoining field of 10 acres, there was very little nematode infestation, less than 1 percent. Neither field had ever produced potatoes prior to this time. The 40-acre block had been in peaches the year before. The peaches, which were affected with nematodes, had been cut down and pulled out and the ground fallowed prior to planting the potato crop. The 10-acre block had been under cultivation for about 8 years, having produced only grain crops.

A 20-acre block of potatoes which yielded only 80 hundred pound sacks to the acre as compared with an average of 150 per acre was found severely infested with nematodes, about 80 to 90 percent. This same block had been in potatoes for the past 3 years. Each year the infestation has become progressively worse. If proper cultural practices had been employed the excessive losses could have been appreciably reduced. In general, nematode infestation of potatoes is more pronounced and causes greater damage to the fall crop (July-September).

THE EFFECT OF CROP ROTATION ON THE CONTROL OF HETERODERA MARIONI ON NORFOLK SANDY LOAM SOIL. K. J. Shaw, U. S. Department of Agriculture, Raleigh, North Carolina.— On an area of land known to be heavily infested with Heterodera marioni rotation experiments have been conducted during the past three years. Two types of plots are used: (1) Inclosure units, 12 by 24 feet, and (2) Field plots, 1/20 acre.

(1) Inclosure Units: Tobacco following velvet beans, bare fallow, oats and bare fallow and Crotolaria spectabilis showed less than 10 percent severe root knot. Tobacco following peanuts showed 14 percent; Soybeans (Laredo) 69.8; weeds (with crabgrass) 75.8; oats and weeds 77.5; and corn, cotton, sweet potatoes, and tobacco 100 percent severe root knot. Tobacco following 2 years' bare fallow showed no severe root knot, following 2 years' herdsgrass (Red top) 8.3; 2 years' lespedeza (Tennessee 76) 83.7; and tobacco 100 percent severe root knot.

(2) Field Plots: Based on 2-year averages, tobacco following peanuts showed 11 percent severe root knot, weeds 35.5, oats and weeds 43.5, cotton 44.3, corn 67.3, and tobacco 93.3 percent.

In the 3-year rotations, based on one year's results, cotton-peanuts-tobacco, peanuts-oats and weeds-tobacco and weeds-weeds-tobacco showed less than 10 percent severe root knot. Peanuts-cotton-tobacco and corn-oats and weeds-tobacco showed less than 25 percent. Corn-cotton-tobacco showed 28 percent, cotton-weeds-tobacco 45 percent, and continuous tobacco 93 percent. Data were also obtained on yield and value per acre but these do not necessarily correspond to the amount of severe root knot.

RECENT FIELD OBSERVATIONS ON TOMATO AND COTTON ROOT-KNOT NEMATODES. C. D. Sherbakoff, Tennessee Experiment Station, Knoxville, Tennessee.—Last year, in a paper before the Southern Division of the American Phytopathological Society, the author reported that in 1938 no root knot was found on any plant of a number of cotton varieties, selections and crosses, grown on a plot at Knoxville, Tennessee, where tomato plants grown the preceding year were all severely affected with root knot. In the same paper it was reported that some root knot was found on cotton in a field near Tiptonville, Tennessee, where no tomato had been grown, but cotton had been grown continuously for a number of years and where even Fusarium wilt-resistant varieties were severely affected, apparently with the wilt and meadow-nematode combination.

In 1939 more than 200 tomato plants of different varieties and selections were grown on the plot at Knoxville, and over 300 in the field near Tiptonville. At the end of the tomato season of 1939, all tomato plants in the plot at Knoxville were free from root knot, while in the field near Tiptonville they were severely affected.

THE DISTRIBUTION AND RELATION OF THE MEADOW NEMATODE, PRATYLENCHUS PRATENSIS, TO FUSARIUM WILT OF COTTON IN GEORGIA. A. L. Smith, U. S. Department of Agriculture, Experiment Georgia.—The widespread distribution of the meadow nematode in wilt soils both in the Piedmont and Coastal Plain suggests its probable important relationship to Fusarium wilt of cotton. This nematode was the predominant species in several fields in which ordinarily wilt-resistant varieties showed considerable wilting. A complete killing of all plants by wilt in other limited areas in fields of susceptible and semi-resistant varieties was likewise attributed to the heavy meadow nematode population. A detailed study of nematode population in a heavily wilt-infested field of Stoneville 2B cotton near Cuthbert showed the meadow nematode to be the predominant species. However, a significant correlation was not established between the number of meadow nematodes and the wilt infection in different parts of the field. A rather heavy infestation of a reniform nematode parasitic on cotton, Rotylenchulus reniformis Linford and Oliveira, 1940, (Described in Proc. Helm. Soc. Wash. 7 (1): 35-42) was also present. The root knot nematode, Heterodera marioni, was found relatively infrequently in the Cuthbert field.

ON THE OCCURRENCE OF THE BANANA NEMATODE (PRATYLENCHUS MUSICOLA [COBB] FILIPJEV) IN THE UNITED STATES. G. Steiner, U. S. Department of Agriculture, Washington, D. C.—Heavy infestations of the banana nematode, a close relative of the meadow nematode, have been found on roots of fig, olive and black walnut received from southern California. Black lesions develop until the root cortex is destroyed; the healthy distal roots of fig may even be amputated by destruction of the axial cylinder. This nematode has recently been found also killing boxwood plants in Virginia.

THE ROOT-KNOT NEMATODE ATTACKING STEMS AND LEAVES OF PLANTS. G. Steiner, U. S. Department of Agriculture, Washington, D. C.—Large numbers of root-knot larvae were observed entering the cotyledons, stems, and leaves of beans germinating in heavily infested soil. Many of the young plants were killed by this extreme infestation before the nematodes could multiply and thus acted as a trap crop; the next planting of beans showed only slight infestation.

SOME FURTHER OBSERVATIONS ON THE NEMATODE FUSARIUM-WILT EXPERIMENTS AT LUMBERTON, NORTH CAROLINA. A. L. Taylor, H. D. Barker, and P. H. Kime, U. S. Department of Agriculture.—In 1939 the set-up was similar to that of 1938 reported on at the New Orleans Meeting. (Phytopath. 29: 752) The results for 1939 were not materially different. The carbon-bisulfide treatment controlled disease sufficiently to enable the various wilt-resistant and wilt-tolerant varieties of cotton to become established and make a satisfactory growth. Only a moderate amount of wilt developed in the treated plots. In the untreated plots few plants had not been killed by the middle of July. Sea Island was the only variety that stood up in the untreated plots. It was not killed, but was severely stunted. Root knot was abundant and a great many secondary roots had been killed by the meadow nematode. It is encouraging that Sea Island was able to live and to send out new secondary rootlets, although it made poor growth.

There was no conclusive evidence for varietal differences with respect to resistance either to the root-knot nematode or the meadow nematode. It is true that Sea Island survived and there was a slight indication that the more wilt-resistant varieties such as Coker's 4 in 1 and Cook 307 were able to survive somewhat longer than were the less resistant varieties such as Delta Pine 12, Mexican Big Boll, and Miller. It was felt that these differences were due to wilt resistance characteristics rather than to nematode resistance, although the marked differences between carbon-bisulfide treated and untreated plots suggested that abundance of nematodes influenced infection by the wilt organism. Sea Island thus has some characteristic which even the most wilt-resistant uplands do not possess. Hence further experiments with Sea Island-upland hybrids and backcrosses may be profitable for producing a combination of wilt and nematode resistance.

NEMATODE POPULATION AND SPECIES DETERMINATION STUDIES ON SOILS FROM THE REGIONAL COTTON WILT PLOTS. A. L. Taylor, U. S. Department of Agriculture, Tifton, Georgia, and A. L. Smith, Georgia Experiment Station, Experiment Georgia.—Soil samples from the 12 regional wilt plots, furnished by the members of the Fusarium Wilt Committee in 8 States, were examined for the presence of the meadow nematode Pratylenchus pratensis. Large populations of this species were found in the samples from Allendale, Orangeburg, and Florence, South Carolina, Reidsville, Georgia, and Jacksonville, Texas. A few nematodes of this species were found in the samples from Moundville, Alabama, Hamlet, North Carolina, Tiptonville, Tennessee, and Marianna, Arkansas. No P. pratensis was found in the samples from Alexandria, Alabama,

Tribbett, Mississippi, or Martin, Tennessee. There was no correlation between *P. pratensis* in the samples and 3-year average midseason wilt percentages.

SUGGESTIONS ARISING FROM AN ANALYSIS OF "PLANTS REPORTED RESISTANT OR TOLERANT TOWARD ROOT-KNOT-NEMATODE INFESTATION". Jocelyn Tyler, U. S. Department of Agriculture, Washington, D. C.—In assembling data for a compilation, now in press, on the above subject, there was found a surprising dearth of accurate first-hand information on certain plants. Careful field records are needed on the degree of infestation or resistance to root-knot found in specific grasses and other plants commonly considered resistant, and in other plants which might possibly be found resistant or tolerant. Gross symptoms, either above the ground or below, are not always dependable evidence. A proposed outline for reports is presented as follows:

OUTLINE FOR REPORTS ON ROOT-KNOT INFESTATIONS WITH PARTICULAR REFERENCE TO THE RESISTANCE OF CERTAIN PLANTS

Source of Information
Name of observer
Station or affiliation
Year of observation; of report

Plants Observed
Plant species
Crop variety
Species and variety of rootstock
Species and variety of scion
Season of observation
Length of growth period, to time of observation
Geographical location of planting
Field or greenhouse planting?

Direct Observations
Were roots examined?
How many roots?
In field or laboratory?
Description of root infestation:
  Look for very slight swellings
  How numerous?
  Are egg masses found? (Sometimes external, on very slight swellings.)
  Are egg masses large? Numerous?
  Largest galls: Size and abundance? External egg masses?

Any plants not infested?
What percentage of the planting?
Were these plants possibly growing in "no-nematode" spots?

Percentage of plants lightly infested
Describe infestation on these plants, as above
Any injury to plant growth?
Any loss in crop yeild?

Percentage of plants more heavily infested
Amount of infestation
Amount of injury
Amount of loss

Effect of a light infestation on young plants; on older plants
Effect of a heavy infestation on young plants; on older plants

Information Needed for Interpreting Observations
Soil type
Last crop
How heavily was it infested?
What weeds?
When were old roots plowed up?
Were they removed or left in the ground?
Plants previously grown on plot?
Any evidence of uneven distribution of root-knot in the plot?
Any evidence of uniform distribution of root-knot in the plot?

NEMATODE STUDIES AT U. S. REGIONAL VEGETABLE BREEDING LABORATORY. B. L. Wade, U. S. Department of Agriculture, Charleston, South Carolina.—Under field conditions at Charleston we have rarely had difficulties with nematodes, but in the greenhouse they present a problem every year. Once under field conditions we had a severe nematode attack on tomato varieties, but not on any other crops. Whenever infestation occurs we look for variety or strain differences in the crops involved.

At the present time we have crosses with Alabama No. 1 pole bean to attempt to incorporate its nematode resistance with bacterial blight and mosaic resistances of other beans now being worked with.

We plan to extend our studies somewhat to include identification of the nematodes involved and to include some controlled studies of varietal reactions of the vegetables included on our breeding program (except corn, which appears immune).

We will not have much money to devote to this work but we do have adequate greenhouse, laboratory, and office facilities available so that work could be done here by any division wishing to do fundamental or control work with nematodes.

CHEMICAL TREATMENT OF SOIL TO CONTROL THE ROOT KNOT NEMATODE. P. A. Young, Texas Agricultural Experiment Station, Jacksonville, Texas.—Several chemicals were tested to determine their value in controlling Heterodera marioni in sandy soil. Extensive tests showed that chloropicrin injected into the soil at rates of 300 to 600 pounds per acre usually controlled 90 to 100 percent of the root-knot nematodes. Likewise, injection of 1000 to 3000 pounds of carbon bisulfide per acre controlled all or most of the root-knot nematodes in numerous tests. These two chemicals controlled the nematodes efficiently only when the soil was covered during 4 or more days with paper coated with animal glue, casein, or vegetable paste. Comparative tests showed that wetting the top 2 to 3 inches of soil with water immediately after injecting these chemicals confined the chemicals in the soil so well that the water cover was nearly as efficient as the glue-coated paper in retaining the chloropicrin gas. Fumigating soil with chloropicrin at the rate of 10 c.c. per cubic foot of soil controlled soil-borne parasites. Formaldehyde, cyanamid, and sodium hydroxide were not effective in decreasing the abundance of nematodes in the soil. In the control of nematodes, watermelons were used as test plants in the treated and untreated soil to ascertain the effectiveness of the treatment. Usually 75 to 100 percent of the watermelon plants had root-knots when grown in the untreated (check) soil. Evidence was secured that the pocket gopher carried root-knot nematodes from untreated soil into disinfected soil of a hotbed. (Technical Paper 585)